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OF CEYLON.

Edited by

J. LAMB, M. Sc., A. R. I. C., A. I. C. T. A.
Acting Director, Tea Research Institute.

THE TEA RESEARCH INSTITUTE
St. Coombs, Talawakelle.

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The Tea Research Institute of Ceylon.

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The Laboratories of the Institute are situated at St. Coombs Estate, Talawakelle, and letters and enquiries should be addressed to the Director, Tea Research Institute of Ceylon, St. Coombs, Talawakelle. Telegraphic Address :—Research, Talawakelle. Telephone, Talawakelle 44 (Private Exchange). It is particularly requested that letters should not be addressed to officers by name.

NOTES ON CONTOUR PLANTING

By

F. C. DANIEL

An Ordinance, promulgated in the Ceylon Government Gazette No. 10,006 of August 10th, 1949, requires any land opened in tea to be "planted on the contour or as near the contour as the lie of the land may permit." This Ordinance is of such importance that the relevant sections are reprinted in full below: Tea Control Act, No. 28 of 1949.

Notification No. 1.

Regulations.

17. Every holder of a licence to plant tea shall adopt, before he commences so to plant, the following measures for the conservation of the soil of that land—

(1) Shade trees must be planted at suitable intervals so as to provide a soil mulch and to minimise the effect of the beating action of rain on the soil.

(2) The tea must be planted on the contour or so near the contour as the lie of the land may permit.

(3) Contour stone terraces or contour hedges of plants providing green manure or of suitable close growing perennial plants must be made between the lines to be planted with tea.

(4) All lateral drains must approximate to the contour and be so designed that the surplus storm water they carry spills into existing natural drainage lines, leader or storm drains.

(5) All lateral drains must be provided with silt pits, lock and spill or reverse slope sections designed to bring about the maximum absorption of rainfall on the spot and to minimise run off.

(6) The upper margins of all lateral drains must, where possible, be protected from erosion by means of hedges of tea or of natural vegetation or of suitable material.

(7) All natural drainage lines must be maintained as leader drains.

(8) Every natural drainage line, leader drain or storm drain shall be interrupted, at such intervals as the angle of fall and the length of the outlet may demand, by stops designed to check the rate of fall and to minimise gully erosion."

The best method to employ in this form of planting is to measure the width between contours, down the main ridge in the area to be planted. There is no need to have the whole clearing bared if it is in grassland, while any existing cover crops should be retained.

Having marked off the required spacing down the ridge, trace a level line, right across the face of the clearing from a mark approximately half way down, with the ordinary road tracer, marking it with pegs at intervals. Taking this level line as a base, commence another level line from the mark above or below

and trace in another level line and so on. At this point it may be noted that the use of differently coloured pegs for alternate contours will greatly assist subsequent work and eliminate any possibility of confusing different contours. It is very probable that the contours when put in level will run closer to each other on steeper land such as natural ravines. In this case discretion will be necessary as to whether to deviate from the level and slope the contour down slightly in order to obtain the same spacing, or whether to terminate the contours when they get too close, so making a short row.

It may be said that short rows will make supervision of plucking difficult. This is not an insurmountable obstacle since short rows occur in the majority of areas planted up and down hillsides. A way of overcoming this difficulty is to give each plucker an area between green manure trees, or between drains, especially if tea hedges are planted on the upper sides of the drains.

Having finished pegging in the contours, the pegs must be treated as either the top or lower pegs of the trenches that are now to be cut. It is suggested that the trenches should be not less than eighteen inches wide and of the same depth. If the lowest trench in the area is cut first, the grass and weeds above it can be scraped into it. A certain amount of soil from the next trench will also follow the grass and weeds. The longer these trenches remain open and the greater the amount of leaf droppings and compost which is put into them, so much the better will be the growth of the tea plants when supplied.

In replanting old tea areas, where there is such an urgent need for soil improvement that it is essential to keep the trenches open for a considerable period, it is preferable to start by cutting the top trench first. Although this may mean that on steep slopes some of the spoil from this trench will again have to be shifted in cutting the next lower trench, this method does ensure that the trenches when cut are left clear and so may be completely filled with loppings, compost, etc.

Field drains will, of course, have to be traced and cut in at the same time as the contours. They should be of a very slight slope and the bottoms provided with a series of steps at 10 to 12 feet intervals so cut as to produce a backward slope between steps. Alternatively, these drains may be bunded.

Immediately all excavation work has been completed, lines of bush green manures should be sown between the lines of trenches and tea hedges planted above all drains and paths. At the same time a start should be made with the establishment of such medium and high shade as is agreed upon. On the St. Coombs new clearing it is proposed to defer the actual supplying of the tea plants for some 18 months or so, thus permitting time for the supply trenches to become more or less filled up with green manure loppings, compost, etc. This delay is, of course, not always essential but may be expected to prove well worth while by reason of the greatly improved growth shown by the young tea when it is subsequently planted. If poor areas of old tea are being replanted in this manner, then it must be taken for granted that a period of at least two years spent in soil improvement is essential.

The advantages of contour planting are manifold. It permits the planting of a greater number of bushes per acre, with the consequent possibility of higher yield. It is however primarily of greatest importance in the prevention of soil erosion as a consequence of the terraces that form very quickly along the lines of the tea bushes. These terraces become level and, when regularly cultivated, a minimum of rainfall will run-off from one terrace to another even in the heaviest cloudburst.

On the question of spacing, no hard and fast rule can be given since the optimum spacing to be adopted depends very much on the lie of the land. However, the following experience on St. Coombs may be of interest.

PLATE 1.

General view of 1938 new clearing on St. Coombs.

PLATE 2.

Close up of 1938 new clearing on St. Coombs showing supply trenches.

Two areas, with varying gradients of land were cleared and opened on this estate in 1937 and 1938. One area was planted up with contours 4 feet apart and the plants in the contour 2 feet apart, while the other was supplied at 5 feet and 1½ feet respectively. The yields from these areas were far ahead of an area planted up and down the hillside in the previous year.

The area planted at 1½ ft. in the contours came into bearing in 1942 and yielded 1,237 lbs. per acre in 1945, while over its first seven years it averaged 805 lbs. per acre. The number of bushes per acre is about 5,737. This clearing has formed very much the better terraces indicating that a closer spacing than 2 ft. between the bushes is advisable for soil conservation purposes. On the other hand the 4 ft. wide rows appear to be too narrow for satisfactory working on our slopes.

VEGETATIVE PROPAGATION OF TEA BY NODAL CUTTINGS

F. H. KEHL.

Introduction.

The growing of tea in Ceylon began with the planting of seedlings. It has now developed into one of the major industries of the country and, in spite of the many years of commercial culture, seedlings continue to be planted, thereby filling tea gardens with heterogenous mixtures.

More than forty years ago, Dr. C. P. Cohen Stuart, who was the first tea selectionist, wrote: "Ceylon tea is an awful medley of tea hybrids and Ceylon as a seed producing country stands in very bad repute among Java planters, however good its manufactured tea may be." Since then there has been considerable improvement in seed gardens, but the selection of seed trees alone will not bring about the fixation of desirable characters, so long as the means of propagation is by seed. Tea, like other cross-pollinated plants does not grow true to type, but produces a mixture of plants, having good and bad qualities with many variations. The variations seen in tea fields are, the differences in the colour of leaves, shape and size of leaf, the tendency to produce banji shoots, the length of nodes and resistance to pests and diseases.

That many of these variations influence the cropping capacity of a bush is apparent. On making individual yield records of small areas, startling differences have been obtained. Two acres of good uniform tea comprising (a) 1,000 bushes at St. Coombs[1] and (b) 1,515 bushes at Galatura[2] were chosen, and the number of shoots plucked per bush recorded for five rounds. The following classifications resulted —

TABLE I.

(a) ST. COOMBS.

Total No. of Shoots	Number of bushes giving this yield	Total No. of shoots	Number of bushes giving this yield
20-39	15	160-179	40
40-59	59	180-199	25
60-79	175	200-219	9
80-99	255	220-239	3
100-119	217	240-259	1
120-139	134	260-279	3
140-159	63	280-299	0
		300-319	1

TABLE II.

(b) GALATURA.

Total No. of Shoots	Number of bushes giving this yield	Total No. of shoots	Number of bushes giving this yield
0-19	18	340-359	12
20-39	62	360-379	13
40-59	91	380-399	4
60-79	130	400-419	3
80-99	182	420-439	5
100-119	191	440-459	2
120-139	175	460-479	3
140-159	146	480-499	2
160-179	114	500-519	3
180-199	89	520-539	1
200-219	82	540-559	1
220-239	42	560-579	0
240-259	39	580-599	1
260-279	34	600-619	0
280-299	34	620-639	0
300-319	18	640-659	0
320-339	16	660-679	1
		980-999	1

These figures clearly illustrate that the vast majority of bushes growing on tea estates are low yielders.

The low average yields of the above areas can thus be chiefly attributed to the planting of unselected material, though there are other causes, e.g., the bushes may be diseased, growing in poor soil, or badly pruned, etc. In view of the above, it is of paramount importance to eliminate all unproductive types that take the same labour to look after as good ones, and to concentrate on planting bushes that will yield well, and give first class quality, thereby reducing costs to a minimum.

In many other crops, very far reaching financial and economic results have followed the application of the selection of favourable types and the multiplication of these by suitable vegetative methods, to ensure the maintenance of their characteristic properties. Propagation of citrus, and other fruit trees is quite simple and has extended beyond the nurserymen to the grove owner himself. Today all owners of orchards, and even those with a little space in their back gardens use standard types propagated vegetatively.

It would be a sound policy for estates to follow the example set by fruit growers in using plants grown vegetatively from carefully selected trees. It is fortunate that the propagation of tea is quite a simple process. This is of great value in the work of selection, for it aids the fixation of the best types in a very much shorter time, and at a more economic cost than is possible from seed.

Several procedures in general use, which will have a certain amount of interest both to agencies and superintendents are set out below. In addition to the discussion on propagation, some notes are included on selection and maintenance of records. It should be remembered that there are still considerable differences of opinion concerning their relative merits. For this reason no attempt has been made to give the final word on the subject, but only to express what seems to be sound opinion based upon our present knowledge.

Selection.

Selection of Mother Bushes.—The first criterion to adopt in selecting mother bushes must be yield, as it is the simplest character to assess. Selection of

apparently high yielders, when first undertaken by the Institute, was made by the following technique:—Pruners were instructed to leave four or five large bushes unpruned each day, avoiding all roadside bushes, bushes adjoining vacancies, and double bushes. On the field being completed all bushes wrongly left were pruned by a peon. From those remaining, an assistant selected the best and rejected the rest. All bushes selected were labelled, given a cut-across, and brought into plucking after six weeks. The leaf from the first two plucks was discarded and thereafter the bushes were plucked weekly. The yields were recorded either by flush counts or by weight. At the end of every eight plucks the lowest yielders were discarded, according to the following scheme:—

TABLE III.

	8th Plucking	16th Plucking	24th Plucking	32nd Plucking
Start	1st discard	2nd discard	3rd discard	4th discard
Rejected 0	50	25	8	6
Retained 100	50	25	17	11

On the analysis of the results of the initial work on selection it was found that it was unnecessary to keep records for lengthy periods, eight plucks being sufficient to give a fair estimate, as the early high yielders continued to be good yielders.

The yields of the clones on St. Coombs illustrate that all mother bushes, selected after being test plucked, have not all produced clones of outstanding yielding capacity. Accordingly it would seem to be preferable to devote the time and labour which would be spent in making yield records of individual bushes, to build up a stock of average clones in the nursery. The time factor is of paramount importance in obtaining the superior advantage of vegetative propagation and for this reason alone, it is better to avoid test plucks, select by eye alone and so concentrate on getting material into the nursery as quickly as possible.

The initial selection of bushes can be done by pruners or pluckers. The Superintendent should then examine all selected bushes and discard those which are large for obvious physical reasons and those with the following undesirable characters:—

(a) open plucking tables.
(b) carrying few plucking points.
(c) upright habit or poor spread.
(d) having only a few mature leaves.
(e) free flowering types.
(f) a tendency to produce banji frequently.
(g) short internodes.

He should select easy plucking types that branch freely from the bottom, having a good spread with a dense plucking table and clean frames within the bush.

Selection for Resistance.—After examining the bushes for yield capabilities, the bushes are examined for resistance to diseases and pests. The clones on St. Coombs prove that susceptibility to pests and diseases vary from clone to clone. In selecting bushes where blister blight is prevalent, it would be sheer waste of time and labour to search for bushes that are immune rather than those that display a considerable degree of resistance. What is necessary, is to look for bushes which continue to yield plenty of good pluckable flush during

a severe attack of blister blight. Thus selection for blister resistance is best carried out during blister periods and preferably in younger fields, which are most liable to damage.

There are other diseases, such as meadow eelworm (*Pratylenchus pratensis*), etc., that should not be overlooked. In selecting bushes that are resistant to eelworm, the Superintendent should look out for bushes that are high yielding and vigorous, in an area infested with eelworm. In some estates it may be necessary to look for bushes that display resistance to both eelworm and blister blight. This makes selection more difficult but that such clones do exist has been proved by an estate where the early selection was made for eelworm resistance prior to the advent of blister blight. Some of these clones now display considerable resistance to blister blight as well as being resistant to the eelworm — *Pratylenchus pratensis.*

In areas where drought is of frequent occurrence, drought resisting types are picked out adopting the same principle.

Where shot-hole borer (*Xyleborus fornicatior*) is a menace, besides looking for resistant types, it would be an advantage to search for types that run for a longer cycle.

The number of bushes to be selected initially will vary according to the acreage of the estate, but in deciding on the number, consideration should be given to the fact that about 50 per cent of the mother bushes will be discarded in the nursery due to poor rooting. In fact, there should be no end to selection for one should always try to look out for something better, there being no marking time once selection is started.

Each estate will have its own problems and accordingly it is advisable that each estate should carry but the selection of its own mother bushes. Good types, undoubtedly, do exist in all estates and could be picked out if only the trouble is taken to look for them. It is interesting to note that clones selected from the low-country and subsequently planted on St. Coombs are not doing as well as those in the low-country, and conversely. Similarly, clones that show high resistance to blister blight at low elevations do not always display the same degree of resistance on being transferred to higher elevations.

Treatment of Selected Bushes.—All bushes selected should be labelled. Any type of numbered label attached to a high stake may be used and the bushes fenced in, if desired, to prevent their being plucked. Further it is desirable to provide some method of checking the location of the bush. A plan showing the position of the selected bush in relation to paths and drains is very helpful.

Cuttings can be made from a bush at any stage of growth. Cuttings propagated from good rooters at the end of the cycle still gave good rooting, but such material was difficult to handle. Also the number that could be made from such bushes was very limited. It is best, therefore, to prune the bushes and allow them to grow unplucked until the lower end of the shoots begin to turn woody. The period of time required for this will vary according to climate and elevation. At lower elevations it will take 2-4 months while at high elevations it will take 3-6 months. The type of shoot obtained by this treatment has long internodes and is easy to work with.

Bushes selected at the beginning of the pruning cycle need not be pruned again but can be allowed to grow unchecked until sufficient growth has been made.

It has been found advantageous to break the tips of shoots from selected bushes that have been rested, about two weeks before the cuttings are to be taken. This helps to harden off the upper portions of the stem and give an increase in the number of cuttings that can be taken. The number of cuttings that can be obtained from a single bush varies from 200 to 800 at each harvest.

Method of taking cuttings.—Shoots sufficient to produce the required number of cuttings are removed from the bush, placed in a bucket of water and carried to the nursery. On wet days, however, the cuttings can be transported in baskets to the site, where they are then placed in a vessel containing water. On no account should the shoots be tied tightly into bundles as this will damage the leaves. Before shoots are sent to the nursery it is essential that they should be correctly labelled.

The making of cuttings, which should always be carried out under shade, is a very simple process. All soft and sappy portions together with the portions that have turned woody, i.e., where the bark begins to crack and has greyish streaks, are discarded. (See Fig. 1). All damaged, diseased, or infected leaves should also be discarded.

A sharp budding knife or blade is used in making the cuttings: the greatest care being taken to make the cut cleanly and not to mutilate any part of the individual cuttings, for in many cases the efficiency with which this operation is performed makes all the difference between success and failure. The cuttings when made, should be allowed to fall into a bucket of water, so as to prevent drying out between the taking and the planting. This is especially important with leafy cuttings which lose water very rapidly. The cuttings thus made are best planted without undue delay.

The number of cuttings from each mother bush to be tried out for rooting will depend on the nursery space available, but it should be possible for at least 150 cuttings from each bush to be put out.

Type of cutting.—Green wood cuttings root rather better than red, but in large scale propagation it is necessary to take a mixture of both red and green thereby getting the maximum number of cuttings possible.

Single leaf cuttings, which provide the most material were found to give better results than cuttings with double or treble leaves.

TABLE IV.[3]

Percentage of rooted cuttings at 2½ months.

Single leaf	Double leaf	Treble leaf
51	45	17

The only instance when the use of double nodes is advocated is when the inter-nodes are short. When inter-nodes are short the cuttings are not readily anchored in the soil. Besides, deeply planted cuttings have their bases in a medium whose temperature and moisture content tends to fluctuate relatively little.

The presence of flower buds is generally detrimental to rooting. It has been found that plants raised from cuttings of adult flowering specimens of Begonia and Gardenias have been observed to flower earlier than those from cuttings of immature plants. In tea, too, the taking of cuttings from trees that have reached the flowering stage is best avoided. Generally cuttings from such trees, if propagated, make little shoot growth but merely develop flowers.

There is no disadvantage if the bud in the axil has just commenced to grow, but if much growth has been produced, the shoot is cut back to the fish leaf (Fig. 2). This is done to prevent excess transpiration taking place.

Hormones.—Those growth regulating hormones which have been tried have not given the desired increase in rooting, to justify their use for the propagation of tea. Their use with tea results in a slight increase in rooting on average good rooters, but does not break down any inherent resistance to rooting. The following are some of the results:—

FIGURE 1

TABLE V.[4]

Effect on Rooting of pretreatment with Hortomone A.

Treatment	Percentage Success		
	At the end of 2nd 2 months.	Between 2nd and 3rd month.	Total 3 months.
(a) Strength of Hortomone A Solution.			
No treatments	30	35	65
Normal strength (1 pt. in 320).	48	27	75
Double strength (1 pt. in 160).	62	22	84
(b) Time of immersion in Hortomone A (Normal strength).			
16 hours	—	—	70
32 hours	—	—	79

TABLE VI[5].

Effect on Rooting of Pretreatment with Hortomone A and Urea.

Treatment	Percentage Success after		
	2 months	3 months	4 months
Water	29	54	72
Hortomone A (1 pt. in 320).	40	62	72
Urea (0·15% solu.)	29	55	75
Hortomone A + Urea	33	53	70

TABLE VII[6].

Effect on Rooting of Type of Cutting and Pretreatment with Seradix B.

Percentage Rooted

Treatment	Type of Cutting	
	Red Wood	Green Wood
Nil	49	59
Seradix B. (A strength)	45	51
Seradix B. (B strength)	49	51
Seradix B. (C strength)	48	54
Mean	48	54

FIGURE 2

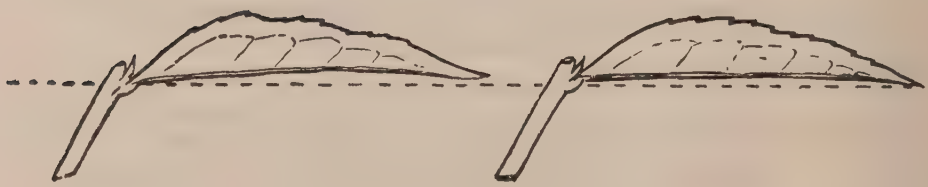


FIGURE 3

The three different strengths of Seradix B had no significant effect though with Hibiscus cuttings they worked very satisfactorily.

Nursery.

The site for a nursery should be carefully chosen. It must be easily accessible and close to a perennial source of water supply. Good natural drainage is most essential and in its absence no other treatment can overcome the deficiency. Special attention must be paid to the physical condition of the soil. By this is meant its texture, humus content, aeration and moisture retaining capacity. Dense textured soils such as clay, soils very sandy or gravelly, and alkaline soils, such as are likely to be found on old line sites, must be avoided.

Cuttings will not succeed in nurseries infested with eelworm. Accordingly it is a good policy not to grow bush covers that are susceptible to the root-knot eelworm (*Heterodera marioni*) on an area that is to be used as a nursery site.

Direct drip on to the beds from overhanging shade must be avoided.

Preparation of Beds.—The area selected should be dug to a depth of 15 ins.—18 ins. and all roots and stones removed and lumps broken down by a mamoty The soil should then be worked over again to ensure a good tilth. If the soil contains much sand, jungle earth and humus should be added to secure the required texture. It is, however, a mistake to incorporate any manure, for cuttings do not root well in a rich soil. Drainage may be provided by removing the soil to a depth of 18 in. and making the base of the bed with clinkers to a height of 4 to 6 inches and then filling up with the removed soil.

The prepared area should then be divided into beds, the width not exceeding 4 ft. and the length about 15 ft. to 25 ft. The surface is then made as even as possible with a slight slope towards the drains, the object being to carry off any rain water. The practice of raising beds more than a few inches is not recommended, for cuttings on edges of high beds suffer in dry weather from lateral drying out and in wet weather from wash.

Before the beds are made even, Gammexane dust D.025 should be sprinkled at the rate of 2 teaspoonsful per square yard over the surface and forked in well. This will reduce the casualties due to damage by cut worms and white grubs. The prepared beds are then allowed to settle down for two weeks before any planting is done.

Planting of cuttings.—The prepared cuttings, as described earlier, taken as required from the water, are inserted up to the axils of the leaves in rows across the beds, the stems being firmed with the thumb and index finger, at such an angle so that the lower surface of the leaf lies flat on the surface of the soil (Fig. 3). Cuttings should be inserted so that the leaves are all the same way. (Fig. 3). A suitable planting distance is 4-6 inches apart in the rows and the same distance between the rows.

Care must be taken when cuttings are planted to see that the cut ends of the stalks are not damaged by peeling or wounding the bark. This may occur if cuttings are pressed into sandy or unprepared beds. Any possibility of such damage may be avoided if a dibbler is used to make holes before the planting operation. One very important point regarding the use of the dibbler must be mentioned, namely, adequate firming of the soil. Lack of this will result in many failures due to a 'pocket' being formed between the base of the cutting and the end of the hole.

Shading.—As each row of cuttings is planted it should be shaded immediately with bracken fern (*Gleichena linearis*) as a few minutes exposure to direct sunlight will cause scorch and result in poor rooting. An efficient method of providing shade, is to insert clusters of fern into the bed between the leaves.

The shade should be fairly dense so that the cuttings are hardly visible when viewed from above. Special attention should be paid to the sides of the bed to prevent the rays of the morning and evening sun falling directly upon the cuttings.

All unnecessary treading of beds can be avoided when planting and ferning, if the work is carried out from the sides of the beds or from a plank placed across the bed.

On completing the planting of a set of cuttings a sprinkling of water is given to dampen the fern and settle the cuttings. When cuttings from more than one bush are planted, a margin of about a foot between each set of cuttings is desirable, so that there will be no doubt regarding the identity of a plant later on.

If planting is done during very dry weather the surface must be lightly dampened before planting which is done under a moveable hessian tent. It is hardly necessary to state that cloudy days should be chosen for any large scale planting.

Type of Shade.—Whatever shade is used it need not be of a permanent nature, but the closer the covering to the ground, as is the case with fern, the less evaporation there will be from the beds and the more even will be the humidity maintained. This latter condition is particularly desirable. Fern is preferred to pandals or sheds as it is cheaper and cuttings under fern harden off better than those under sheds or pandals. Fern dries and thins out shade in the course of time. If a pandal is preferred it must be constructed so as to prevent the sun reaching the cuttings in the mornings and evenings.

Labelling.—The labelling of cuttings, as of the mother trees, is of great importance and a plan of the position of the clones in the nursery beds should be maintained. Metal labels bearing the clonal numbers, the dates of planting, are fixed to round iron posts. These are inserted between the cuttings of each clone.

Care of cuttings.—Watering depends on circumstances and the general principle is to keep the fern moist by a very light sprinkle for the first ten days, and thereafter to water thoroughly every 2 or 3 days, as required, rather than carry out a light daily watering. The correct watering of cuttings is only learnt by experience. Too much watering which keeps the soil constantly moist will cause damping-off fungi to attack the cuttings. On the other hand, if beds are allowed to get too dry by scanty watering, the cuttings will wilt, shedding the mother leaf which is fatal. The best rule in watering is to water thoroughly whenever it is done, then stop all further watering as long as the soil remains moist. A simple method of control is to dig the sides of the beds in places to a few inches depth and examine the state of the soil.

A few days after planting, the beds should be examined and re-ferned where necessary.

Weeding.—Weeding, if necessary, must be carried out through the fern, the shade being thickened up again as the work proceeds. This work is best done during cloudy or damp weather and sunny days should be avoided. No attempt should be made to scrape off moss as the cuttings are liable to be damaged.

Flower buds which appear on cuttings must be broken off as they appear, for if they are allowed to remain, the growth of the cutting will be checked. Any clones that flower frequently are best discarded in the nursery as it is quite evident from our experience that free flowering types are poor yielders.

Cuttings from some bushes root more readily than others, while they also differ in the rate at which they form roots, some taking 2½ months while others

take as long as 4 to 5 months. When cuttings are put out for the first time, it may be an advantage to examine a few rows totalling some 50 to 75 cuttings of each clone in order to determine their rooting capabilities at the end of four or five months. Under estate conditions clones that give a rooting percentage lower than 50 per cent should be rejected, no matter what other desirable characteristics the mother tree may have. The only case when a further trial of an apparently poor rooter is worth while is when there is obvious reason for failures, e.g., when cuttings of a whole bed fail to root, or if some reason can be assigned for the failure. From the clones tested on St. Coombs, it would be reasonable to expect that about 50 per cent of the selected bushes will be discarded due to poor rooting capability.

Manuring Nursery.—At the end of 4 months liquid manure may be applied to the beds to stimulate top growth, as the cuttings will require food for vigorous growth.

Liquid manure is easy to prepare and that from cow dung is safest to use. A basketful of cow-dung is tied in a piece of jute hessian and soaked overnight in a large drum, the liquid being applied once a fortnight. For preparing liquid manure from artificials it is essential that only small quantities be used, e.g., ½ lb. of T.420 in 45 gallons of water. It is important to remember here, as in many other matters, that because a little is good, a lot is not necessarily any better but indeed may be actually harmful. The soil should be wet when the liquid manure is applied. On dry days it is necessary to wet the beds and then apply the liquid manure. After manuring, the beds should be watered again, the idea being to wash off any manure on the leaves or stems which if left might cause scorch. Beds manured regularly must be rested for a considerable time before any more planting is done as cuttings do not succeed in beds rich in plant food.

Centering.—All plants that carry about 8 to 10 leaves should be thumb-nail pruned so as to leave about 3 to 4 leaves on the plant. This early cut will encourage branch formation and any clones that fail to branch after this treatment are best discarded in the nursery. On discarding any clones the labels attached to the respective mother trees must be removed and the bushes pruned.

The Superintendent should attend personally to the layout of nurseries and thereafter entrust them only to well trained and experienced men.

Planting.—After a year in the nursery most clones will have made sufficient growth for planting out in the field and any of the following methods may be adopted to remove the plants from the nursery as either:—

(1) Basket plants, or

(2) Plants ex nursery.

(1). The usual method is to transfer the cuttings, after they have rooted, from the nursery beds into large and strong baskets. The plants thus established in the baskets then go out into the field without any disturbance or damage to their root system.

(2) (a). The plants can be removed by means of a transplanter, e.g., the Hersall transplanter. Such plants are taken out of the nursery with the soil round the roots still complete and undisturbed. This is quite an efficient way of removing plants and our experience is that the 5½ ins. cylinders are preferable to the 4 ins. for clonal work.

(b) The other method is similar to that of planting stumps. A fork is used to remove the plants; great care must, however, be taken to lift them gently with their roots holding as much of the original soil as possible. On no account should the roots be allowed to dry out as they are extremely sensitive at this stage.

Any of the above methods may be adopted to transfer the plants from the nursery to the field, but rough handling of young plants must be avoided if casualties are to be reduced to a minimum.

The plants resulting from the initial propagations should be laid down in "test plots" of about 50 bushes of each clone. After the planting of these plots a sufficient number of plants should be left in the nursery to fill in any vacancies that may occur, while any surplus may be used for supplying the estate; such plants being obviously preferable to unselected seedlings.

It is in the "test plots" that the actual usefulness of a clone is studied. This undoubtedly takes time, but is very necessary as no one can foresee how far the properties of a bush that drew the attention of the selector, are inherent, or merely the result of external factors. Thus, to form a reliable opinion as to whether the productive capacity, resistance to pests and diseases, etc., are inherent characters of the mother bush or not, clones must be grown in such a manner that external factors are mainly eliminated.

Test Plots.—An uniform area which is suitable for growing tea and free from excessive variations in fertility is selected. The simplest method, and one that can be adopted by estates, is to plant the clones in rows, each clonal row containing some 30 to 50 plants. The spacing of all clones must be the same throughout the plot.

The plots on St. Coombs are spaced at 3 ft. along the lines and 4 ft. between rows. This spacing though satisfactory may not be the ideal, as a slow growing clone will be subjected to unfair competition from a relatively vigorous growing clone in an adjoining row. If, however, the spacing between the rows is increased to 5 feet competition will be reduced to some extent.

The plots provide means of making observations regarding the most desirable characters such as relative vigour, rate of development, resistance to diseases and pests, branching habit, ease of establishment, etc. After about a year's growth it is possible to make a good guess as to which will prove the best clones. The best clones may be tested for quality. For such tests the leaf from the respective mother bushes must be used, which will not be very accurate due to the small quantity of leaf that can be harvested. These tests nevertheless, serve the purpose of eliminating undesirable types. The clones that are found satisfactory are then propagated on a large scale for supplying vacancies.

A few plants at the end of these rows may be left to grow so as to provide a continuous supply of cuttings, whilst the rest are given a light pruning when ready and subsequently brought into plucking. Prunings too provide useful material for the taking of cuttings. On St. Coombs, clones about three years old gave 150-200 cuttings per bush from prunings.

At the end of a year's plucking a certain number of undesirable clones, i.e., very poor branching types, low yielders and those susceptible to pests and diseases are rejected. All promising clones should now be tested for quality and it is at this stage that the Institute would be prepared to carry out manufacturing tests. A few tests are necessary to weed out all the poor quality clones. At the end of one cycle such a test plot is almost certain to produce some outstanding clones.

Non-fermenters are rare and it should be realised by those who undertake rough fermentation tests that all shy fermenters do not necessarily make poor quality teas. It was found at St. Coombs that some of the good quality clones were not very good fermenters.

Manuring.—The plants in the plots are manured and forked lightly, preferably twice a year during suitable weather conditions with a mixture made up as follows:—

TABLE VIII.

...	Lbs.	Nitrogen	Phos. Acid.	Potash
Sulphate of Ammonia	100	20.6	—	—
Saphos phosphate	50	—	14.75	—
Muriate of potash 50%	30	—	—	15.0
	180	20.6	14.75	15.0

The dosage may be varied with age from planting according to some such scheme as below:—

TABLE IX.

Years from planting	...	Application rate — lbs. per acre per annum.
Up to 1 year	...	180 lbs.
1 to 2 years	...	270 lbs.
2 to 3 years	...	360 lbs.

It is essential that each plant is given approximately the same quantity of manure at the time of application.

Records.—The maintenance of records is essential if success is to be achieved. These need not be elaborate, but should be as simple as possible. It is necessary to maintain detailed recordings such as date of selection of mother trees, date of planting, rooting percentage, date of centering, rate of growth, etc. Specimen sheets to serve as a guide are given in the Appendix.

Planting Clearings.—On St. Coombs the early trials have resulted in a few clones proving to be above the average. The more promising of these, ten in number, are to be used for planting an area of about 5 acres. This attempt to plant a large area with selected clones, even if they are not as good as those available later, will bring about increased production meaning a bigger return for work and better use of the land.

It is proposed to plant these clones in rows as follows:—

1st row	...	...	...	Clone A
2nd „	...	...	...	„ B
3rd „	...	...	...	„ C
4th „	...	...	...	„ D
5th „	...	...	..	„ E
6th „	...	...	...	„ F
7th „	...	...	...	„ G
8th „	...	...	...	„ H
9th „	...	...	...	„ I
10th „	...	...	...	„ J
11th „	...	...	...	„ A
12th „	...	...	...	„ B
13th „	...	...	...	„ C

Another method is to plant individual clones in separate blocks but it is not considered desirable on account of increased liability to attack by specific pests and diseases. For instance, if an area is planted with a single clone, which later becomes susceptible to the ravages of a new pest, the multiplication

of that pest will be much greater, as a result of the concentration of the host in a limited area, than if the clone is planted between rows of resistant types. The same considerations apply to diseases. Nobody can foresee the incidence of new diseases. Blister Blight may be quoted as an example. It is, therefore, very advisable to have a variety of clones in a field and to plant them as suggested.

References.

1. Tubbs, F. R.—Tea Research Institute of Ceylon, 1935, Annual Report. *Bull.* No. 13, p. 54.
2. ——— Tea Research Institute of Ceylon, 1937, Annual Report. *Bull.* No. 18, p. 51.
3. Eden, T. Tea Research Institute of Ceylon, 1940, Annual Report. *Bull.* No. 22, p. 66.
4. ——— Tea Research Institute of Ceylon, 1940, Annual Report. *Bull.* No. 22, p. 68.
5. ——— Tea Research Institute of Ceylon, 1941, Annual Report. *Bull.* No. 23, pp. 63-65.
6. ——— Tea Research Institute of Ceylon, 1948, Annual Report. *Bull.* No 30, p. 48.

APPENDIX.

Record sheets may be kept in separate files as follows:—

FILE No. 1.

SELECTION RECORDS.

Enter date of selection.
Field No.
Position if possible.
Reasons for selection.
Give short description of the bush.

FILE No. 2.

NURSERY RECORDS.

Clone.	Date Propagated	Bed No.	Number of Cuttings.	% Rooted

3 Files may be maintained for the multiplication plots as follows:—

FILE No. 1.

(a) General Records:—

Enter dates of manuring, giving quantities and details of manure applied.
Forked rows should be noted.
Dates of sowing green manures, etc.

FILE No. 2.

(b) Yield Records.

FILE No. 3 (c) Detailed records of each clone.

A separate sheet should be maintained for each clone. On one side enter the following :—

Clone No.....

Position in Plot.

Date selected — giving reasons for selection.

Rooting percentage in nursery.

Date of planting in field, centering, pruning, plucking, etc.

Deaths are entered — Give cause if known.

General description of the clone, e.g., branching habit, rate of growth, vigour, resistance to blister blight, drought, etc.

On the other side of the form details of each bush are recorded in a table as follows :—

CLONE.....

Bush No.	Centered Date.....	Pruned Date.....	Dead	Supplied Date.....	Tipped Date.....	1st Pluck Date.....	Etc.				
1	C					Pl					
2	C	Pr			T	Pl					
3	C	Pr			T						
4		Pr	D	S		Pl					
5					T						
6	C	Pr			T	Pl					
7	C	Pr			T						
8	C				T	Pl					
9					T	Pl					
10	C	Pr									
11	C	Pr			T	Pl					
12	C				T	Pl					

(Reprints of this article may be obtained from the Tea Research Institute, the price being 25 cents per copy, inclusive of postage.)

POTASH REQUIREMENTS OF TEA.*

G. B. PORTSMOUTH.

During the past year or so there has been increasing evidence for the occurrence of what appears to be potash deficiency in Up-country tea areas. This will probably be first noticed as a marked decline in yield resulting from the shutting up of the bushes. Looked at more closely, affected areas are found to be characterised by thin looking bushes which exhibit continuing defoliation of comparatively young leaves. Many of the smaller shoots consist of a large number of extremely short internodes from which all leaves have been shed except for one or two stunted specimens at the apex. This would appear to be the condition often referred to by planters as "Witches Broom." Growth is naturally very much slowed down and in effect it seems that each new leaf is only produced at the expense of an older leaf being shed. Before being shed the leaves normally go through the usual range of senescent colourings, even though they may actually be only a few months old and in extreme cases show marked symptoms of marginal scorching. This marginal scorching was in evidence this year for the first time, in the plots of the St. Coombs manurial experiment that do not receive potash. This experiment, is now at the end of its sixth cycle. The observed effects correspond exactly with the symptoms of potash deficiency in tea described and figured by De Haan and Schoorel (1) as occurring in Java, and which were also artificially reproduced in sandculture.

Accepting for the moment without further proof that the condition I have described is actually due to potash deficiency, let us try to see how it is that this particular deficiency has only recently come into prominance, although tea has been growing for many decades on some of the areas in question.

First let us look at the rocks from which most of Ceylon's tea soils have been formed. These are mainly Archaean rocks of the Charnockite or Charnockite-Khondalite series which on analysis show fair amounts of potash. Some typical figures given by Adams (2) for samples collected in the tea districts are :—

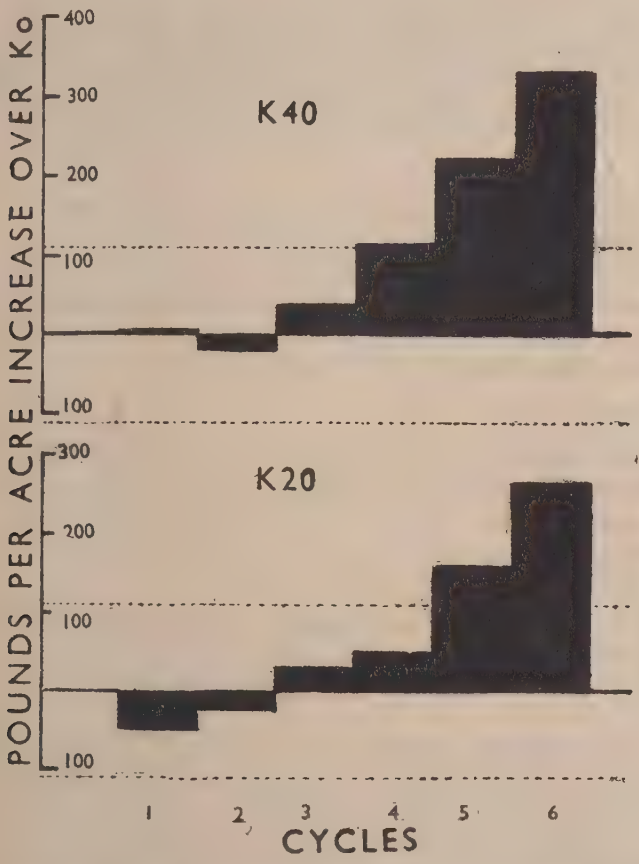
Haputale	...	...	3.48% Potash
Hatton	...	...	...1.33% „
Nuwara Eliya	...	...	3.39% „

There are thus considerable grounds for the opinion, which appears to have been fairly prevalent in Ceylon at one time, that there were likely to be large reserves of potash in the soil. However, even though there may be, or possibly have been, a certain amount of potash reserves in the original tea soils, there is no reason to suppose that all such potash will be present in a form available to the bush nor will such reserves be inexhaustible.

As long ago as 1928 Petch, our then Director, issued a warning regarding possible potash deficiency in an article in the Tea Quarterly entitled "Facts about Fertilisers" (3) but in the ensuing years this seems largely to have been forgotten as no cases of potash deficiency turned up. Further support for

*Address given to the Nuwara Eliya District Planters' Association on 24th November, 1949.

the view that potash manuring was of little importance under Ceylon conditions developed as the first results of the St. Coombs manurial experiment began to come in. This experiment was laid down by Dr. Eden in 1930 and is a three factor experiment in which nitrogen, phosphoric acid and potash manuring are all contrasted at three different levels. Pruning on this experiment was carried out every three years and for the first three cycles there was practically no response to potash at either the twenty or the forty pounds per acre level. However, from the fourth cycle onward, potash responses began to appear and have continued to increase, till this year at the end of the sixth cycle, they are as great, or even greater than, the nitrogen responses. (See Appendix).



On the diagram I have represented our results as increases in crop due to potash manuring. Looked at in another way, however, they may be taken to represent the loss of crop resulting from an absence of potash in the manure. Thus taking the first 10 years of this experiment to have given no potash response it is obvious that the potash reserves of the St. Coombs soil have been more than sufficient to permit the production of a total crop over this period of some 6,000 lb. per acre. From here on, however, the soil is becoming more and more exhausted until at present there is evidence of marked potash deficiency.

Now what is the actual amount of potash required to produce a crop of tea? Put in another way, how much potash is permanently removed either in the flush or in the prunings for each 100 lb. of made tea produced during a cycle. By analysing samples of flush and wood from the first four cycles of the

St. Coombs experiment, Dr. Eden arrived at the figure of 3½ lb. of potash as being removed for each 100 lb. of crop (4). This figure is of course only a tentative one but it is one with which I find myself substantially in agreement. If anything, this figure is probably too low since in arriving at his estimate, Dr. Eden took the potash content of the flush to be only 1.6 per cent of the dry weight, whereas in several analyses that I have had made, I have found potash contents of flush as high as 2.5 per cent of the dry weight. Accordingly, I am inclined to prefer a figure of 4 lb. potash per 100 lb. crop as being somewhat more realistic. However, in adopting Dr. Eden's figure in what follows I am unlikely to be accused of putting out potash requirements too high.

This is all very well, you may say, but how are you going to confirm your diagnosis of supposed potash deficiency? My answer to this question is to take this figure of 3½ lb. potash which is removed by each 100 lb. of crop and use it as a yard-stick to compare the actual potash requirements of a particular field with the amount of potash that has been returned to it as fertiliser. Let me show you what I mean by some actual examples:—

FIELD A.

Tea very thin with marked potash deficiency symptoms including marginal scorch.

Yield over past 9 years 6,167 lb. per acre.

Potash requirement at 3½ lb. for each 100 lb. crop= 216 lb. per acre.

Potash applied as fertiliser = 59 lb. per acre.

Actual potash deficit = 157 lb. per acre.

FIELD B.

Bushes very thin and unable to hold leaf. Last pruned October, 1945.

Yield for the present cycle up to May 1949=2,986 lb. per acre.

Potash requirement at 3½ lb. for each 100 lb. crop = 104.5 lb. per acre.

Potash applied as fertiliser = 14 lb. per acre.

Actual potash deficit = 90.5 lb. per acre.

This figure, it should be noted, represents the potash deficit for only one cycle whereas that for Field A covers three cycles.

FIELD C.

Although only one year from pruning, the bushes in this field had lost practically all their old leaves. Those mature leaves still remaining on the bushes showed, in nearly all cases, marked symptoms of marginal scorch, while top growth had obviously been much restricted as was shown by the very small leaves produced. Cropping almost nil.

Yield over past 10 years = 7,204 lb. per acre.

Potash requirement at 3½ lb. for each 100 lb. crop = 252 lb. per acre.

Potash supplied as fertiliser = 63 lb. per acre.

Actual potash deficit = 189 lb. per acre.

I could quote many similar examples but they all tell much the same story of shortage of potash. Thus on St. Coombs itself, over the six-year period from 1943-1948, we have an overall potash deficit of more than 100 lb. per acre. What does emerge from a study of the yield and manurial figures of these various fields is that in almost all cases, it is the highest yielding fields on the estate which display symptoms of potash deficiency and which at the same time also show the largest potash deficits on the basis of fertiliser applications.

The reason why potash deficiency is in evidence at the present time is quite obviously a direct result of the war years which led to the introduction of fertiliser rationing in Ceylon and the almost complete disappearance for some years of any potassic fertilisers. This lean period covers approximately the last decade so that a shortage of potash has existed for about the same time as was required in the St. Coombs manurial experiment to deplete the soil of its potash reserves and obtain significant potash responses. With high yielding fields the rate of depletion of the soil reserves will naturally be higher, so it is only to be expected that symptoms of potash deficiency will appear first in these fields as is found to be the case in practice.

A further factor leading to the development of a state of potash deficiency is undoubtedly to be found in the heavy food crops grown during the war years. Many estates interplanted sweet potatoes in their tea and took off crops at the rate of several tons per acre. Without taking into account the potash in the vines themselves, I estimate that each ton of sweet potato tubers harvested represents the removal of some 13½ lb. of potash from the soil. It would appear that such estates are now having to pay for their patriotism in the shape of potash deficiency.

A further method of checking up on potash requirements, which unfortunately owing to shortage of analytical staff is still only in the tentative stage, is leaf analysis or foliar diagnosis. For this purpose, samples of ordinary plucked flush from the fields in question are collected and analysed for potash. Only a very few analyses have been carried out so far but the results appear to be definitely promising. Let me quote an example :—

Estate D.

	Potash as percent of dry matter
Poor field (P2)	2.10%
„ „ (P3)	2.14%
Good field (P4)	2.55%
„ „ (P5)	2.52%

Indications are, however, that the normal potash content of flush varies from district to district and also probably with elevation. Accordingly it is unlikely that it will be possible to make a valid diagnosis on the basis of leaf potash content alone until such time as a considerable body of analytical data has been accumulated.

In conclusion, what are we to do about potash deficiency ? Here, fortunately, the answer is simple. It is to give an adequate potassic fertiliser application and if necessary rest the field until such time as an adequate cover of foliage has been restored and normal growth resumed. Then provided adequate fertiliser applications are maintained in the future, there is no reason to anticipate a recurrence of this deficiency condition. I may add that good reports are already beginning to come in from estates where this treatment has been carried out.

References.

(1) De Haan, I. & Schoorel, A. F.—Kaligebrek in de Theecultuur. *Archief voor de Theecultuur*, XIV, p. 43, 1940.

(2) Adams, F. D.—The Geology of Ceylon. *Can. J. Research*, I, p. 425, 1929.

(3) Petch, T.—Facts about Fertilisers. *Tea Quarterly*, I, p. 97, 1928.

(4) Eden, T.—*Monograph on Tea Production in Ceylon*, No. 1. The Work of the Agricultural Chemistry Department of the Institute, 1927-1948. Table XIII, p. 27, 1949.

APPENDIX

ST. COOMBS MANURIAL EXPERIMENT.

DRY MATTER YIELDS FOR POTASH TREATMENTS (LBS. PER ACRE.)

Cycle Years.	Treatment	1st Year		2nd Year		3rd Year		Cycle	
		Yield	Increase	Yield	Increase	Yield	Increase	Yield	Increase
1930-33	K0	518		952		672		2142	
Cycle 1	K20	509	— 9	932	—20	653	—19	2094	—48
	K40	517	— 1	961	— 9	670	— 2	2148	+ 6
1934-37	K0	419		860		574		1853	
Cycle 2	K20	409	—10	851	— 9	569	— 5	1829	—24
	K40	407	—12	845	—15	581	+ 7	1833	—20
1937-40	K0	435		671		503		1609	
Cycle 3	K20	443	+ 8	685	+14	511	+ 8	1639	+30
	K40	434	— 1	684	+13	531	+28	1649	+40
1940-43	K0	559		1062		701		2322	
Cycle 4	K20	550	— 9	1085	+23	736	+35	2371	+49
	K40	553	— 6	1105	+43	781	+80	2439	+117
1943-46	K0	420		878		822		2120	
Cycle 5	K20	450	+30	932	+54	899	+77	2281	+161
	K40	453	+33	941	+63	951	+129	2345	+225
1946-49	K0	357		819		580		1756	
Cycle 6	K20	409	+52	935	+116	678	+98	2022	+266
	K40	416	+59	960	+141	716	+136	2092	+336

Note on Significance.

The average values of the significant differences are approximately as under—

Annual Yields S.D. = 50.
Cycle Yields S.D. = 110.

ROOT DISTURBANCE WITH SPECIAL REFERENCE TO TEA CULTIVATION*

H. C. PATERSON.

There has been, of late, much controversy on the subject of "Root disturbance," but what is really meant by root disturbance ?

No tea cultivation can be carried out successfully without some root disturbance, this is logic.

The feeding roots, which absorb the nutrients of fertilisers; cannot function properly in hard soil, and can only do so in loose soil, which implies that the soil would have to be fairly well broken up, or loosened, by the aid of forks.

With tea in its present condition a great deal of harm could result from shallow forking or just dibbling in fertilisers.

I predict, that quite an appreciable drop of crop will take place within three years, if this system of applying manure is persisted in.

No cultivation should be permitted where there is definite root destruction, this is quite wrong, and should be discontinued at the earliest possible date.

There are several schools of thought regarding the method of applying fertilisers with the aid of forks, and may be classified as follows :—

(a) To avoid root disturbance, some Planters believe that the soil should only be very lightly forked, the soil disturbed only once in the year, and that only every alternate row should be so forked. This means that only half the soil area will be forked and manured, the other half of the area lying fallow.

(b) There is another school of thought which considers that the manure or fertiliser should be only dibbled in the width of the fork, every alternate row, disturbing the root system as little as possible.

(c) There is another system where the manure or fertiliser is forked in lightly after cultivation.

(d) There is yet another system, where the ground litter and green loppings are forked in, with the manure or fertiliser broadcast over the loppings and the whole put under the soil by envelope forking.

(e) The majority of estates apply the fertiliser by broadcasting it down the row. This method of applying manure can be widely abused by the person applying the manure, who invariably just chucks the manure haphazardly down the row. The bulk of the manure falls on the side of the bushes, which is likely to scorch the foliage, and, if there is anything like a wind blowing at the time of application, most of the fine powdery manure is carried away by the wind.

If manure is to be carefully applied and reach the soil, the person applying the manure must stoop over, so that his hand is only about six inches above

* The Institute does not necessarily endorse the views expressed in papers contributed by others than members of the staff.

ground level. In this way manure will actually reach the area to be forked, and not be wasted. This is most important if the application of fertilisers is to increase Tea yields.

Another method of safeguarding the application of manure or fertiliser is to spread the manure in a semi-circle round each individual bush, which also makes the supervision of manure application easier than by the broadcasting method.

It will be noted that all the above mentioned methods of applying fertilisers will involve a certain amount of root disturbance, and in fact no proper tea cultivation can take place without some root disturbance.

To answer the question of what is meant by "root disturbance," one must have some knowledge of the tea root system, how it behaves, and its relationship to the branch system, and to what extent adequate tea cultivation can take place without unduly disturbing the root system.

The root system of the tea bush sends out "feeding rootlets" twice in the year, March/April, and again during November December, and from experience this applies to the S. W. and N. E. zones.

The very name "feeding rootlets" implies that it is this part of the root system which absorbs the nutrients, and it would appear correct to surmise that the manure or fertiliser should be applied a month or six weeks prior to the appearance of the feeding rootlets. Therefore, manure should go out during January and early February, and September October. The time of these applications may have to be guided by weather conditions, when droughts are experienced.

The life of the feeding rootlets is a short one. After 3 to 4 months, they die back, and are replaced by a fresh growth in about 4 to 6 months time. Feeding rootlets appear along the latter half of lateral roots, and cannot be mistaken by reason of their dense silvery appearance.

Reverting to the question of root disturbance, it will be seen how very important it is that the lateral roots should not be broken or snapped off during the process of forking.

The correct way to carry out forking is to put the fork into the soil at the angle shown in illustration (Fig. 1), and to force it down gradually by placing the foot on the prongs, and using the weight of the body. Force the fork forward slowly, and then put the ground litter and green loppings under the soil behind the fork with the aid of the foot. The fork spacings should not be more than 6 inches apart.

If the forking is carried out in this manner, the least possible damage will be done to the root system.

The chief faults of careless forking, which cause the destruction of lateral roots, are as follows :—

(a) Putting the fork into the soil at too great an angle, and if the fork is raised too suddenly the roots will snap, causing considerable damage to the root system. (See illustration Fig. 2.).

(b) The fork spacings are usually too far apart and will average anything up to 18 inches. This type of work makes it easier for the labourer, but the manure cannot be properly applied, and will result in decreased yields, if persisted in.

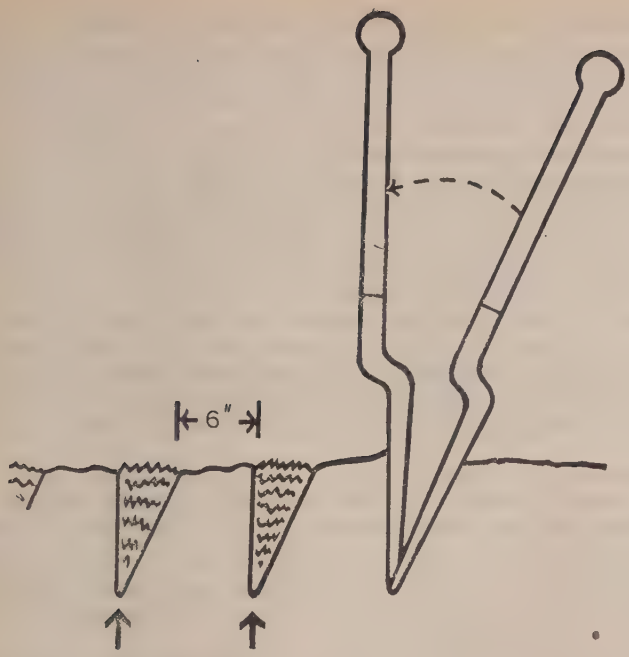


Figure I.

THE CORRECT WAY TO CARRY OUT FORKING.

The fork should be put into the soil at the angle shown and forced down gradually by placing the foot on the prongs, using the weight of the body. Force the fork forward slowly and then put the ground litter and green loppings under the soil behind the fork with the aid of the foot. (Position of incorporated material is indicated by arrows). Fork spacings should not exceed 6".

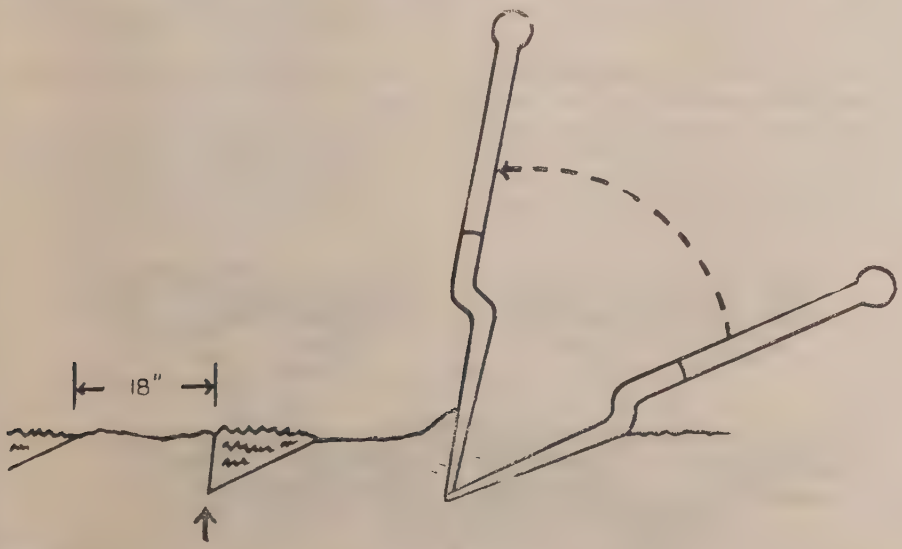


Figure II.

THE WRONG WAY TO CARRY OUT FORKING.

The fork is put into the soil at too great an angle. If the fork is raised too suddenly many lateral roots will be snapped. Fork spacings are also too far apart.

Relation between Roots and Branches of the Tea Bush

It is not widely known that every individual branch is fed by an individual root system. It is obvious that to get the best value out of manures applied to the soil, the maximum number of feeding rootlets should be made active by applying manure in every row, instead of every alternate row as has been the normal practice for years past.

It stands to reason that if manure is applied to one row and not to the other, only a certain number of branches and their groups of flushing points will receive the benefit of the manure applied, whereas if every row is forked and manured the whole of the branch system of the individual bush is benefited, thereby greatly assisting higher yields.

There will be overwhelming opinion to the effect that to fork and apply manure in every row will cause excessive root disturbance, but from my experimental plots this has not been the case, when forking has been carefully carried out. There has always been an improvement in the condition of the tea followed by improved yields, where the manure has been applied in every row.

Burying Prunings in Pits.—This is yet another method of tea cultivation which was widely carried out many years ago, but this system of putting prunings under the soil is now adopted only by a minority of estates.

Mr. Joseph Fraser, a well known Visiting Agent, some 40 odd years ago, was a firm believer in Burying Prunings in pits, but I can remember that quite a lot of root disease, in the S.W. zone was caused through this method, and the practice was discontinued.

This method of adding humus to the soil fell into disrepute for the following reasons :—

(1) The serious amount of root disease which was caused.
(2) The heavy soil erosion which took place.
(3) The formation of "runnels" which occurred between the rows of teas.

There is no valid reason for thinking that these defects of this system in the past do not still apply.

It is characteristic of Ceylon that it never learns from the lessons of the past.

The severance of large roots makes the entry of destructive fungi an easy matter, more especially in the wet S.W. zones.

To bury prunings in anything like heavy tea, pits 22 inches long, 18 inches broad and 9 inches deep will be required to get the prunings under the soil, and even then, there is a large heap of earth, resembling a new grave on the top of the prunings, which is very liable to serious soil erosion from heavy rains and high winds. (Fig. 3).

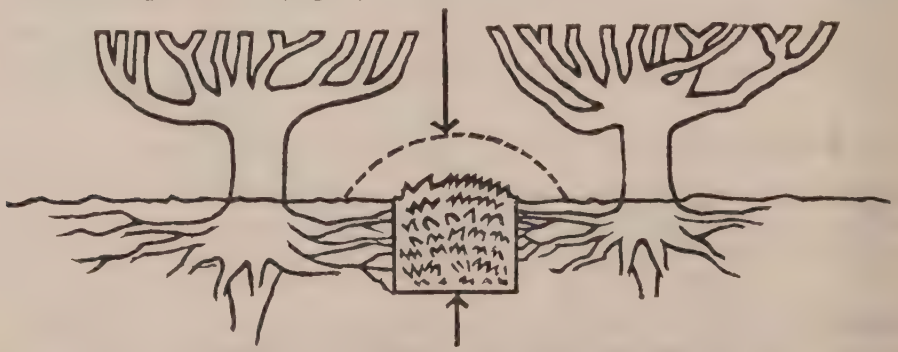


Figure III.

BURYING OF PRUNINGS.

The piled up heap of earth resulting from cutting the pit (lower arrow) is indicated (upper arrow).

The method of cutting pits, is one pit to every four tea bushes, and if the tea is planted 3,200 bushes to the acre, 800 holes 22 inches × .18 inches × 9 inches will be needed for every acre treated in this manner, and the average cost of this work, at the present moment is some Rs. 45/- per acre, if carefully carried out.

There is a considerable amount of lateral root destruction when cutting these holes, and I find on collecting destroyed roots that the average weight per hole is 3.93 lbs. of destroyed fresh roots. At 800 holes per acre, the total root destruction per acre is 3,144 lbs. or Ton 1-8-0-8 lbs., and this is very considerable.

If the pruning is on a 4 year cycle, the root destruction will be Tons 2-16-0-16 lbs. in 8 years, and over 16 years each hole would have been cut twice over.

Although wonderful yields have been obtained from burying prunings and adding lines refuse in pits, immediate results must not be expected, it is a long term policy, and the period may be any time between 7 and 9 years before really high yields are obtained.

However, where burying prunings in pits has been carried out continuously over the past 15 years, there are now definite signs of a depression in the soil between the tea rows, better known as runnels. This is inevitable.

These runnels will lead to serious rain wash in time, unless terraces are built every 10 feet apart.

The above constitutes the principal objection I have against this method of adding humus to the soil, coupled with the root destruction while cutting the holes, and the risk of destructive fungi entering the damaged roots in wet zones.

NOTICES.

The Institute's Laboratories and Offices are situated at St. Coombs, Talawakelle, and all applications and enquiries should be addressed to the Director, Tea Research Institute, St. Coombs, Talawakelle.

Specimens and other consignments sent by rail should be forwarded to Talawakelle Station C/o. Messrs. M. Y. Hemachandra & Co., Forwarding Agents. **Carriage should be pre-paid.**

Visitors' Days.—The **second** and **last** Wednesdays in each month have been set aside as Visitors' Days at St. Coombs Estate and also at the T. R. I. Sub-Station, Gonakelle Estate, Passara, when it is hoped anyone interested will visit the Stations.

Visitors at other times are welcomed but it is requested that an appointment be made if possible.

Guest House.—The Tea Research Institute Guest House is again available for visitors to the Institute. Applications for accommodation should be sent to the Director, Tea Research Institute, St. Coombs, Talawakelle. Meals cannot be provided unless at least twenty-four hours notice is given.

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